10/528446
JC06 Rec'd PCT/PTO 18 MAR 2005

New patent claims

1. Device for checking the authenticity of a forgery-proof marking with colors which change depending on the angle of observation, with

a) several first light sources (1) which are emitting light in a specified spectral range, wherein the first light sources (1) differ from one another in the wavelength of their emission maximum, and wherein the first light sources (1) are installed in a housing (5) so that they irradiate a surface (O) of the marking under a specified first angle ($\alpha 1$) when the housing is placed thereon,

b) several second light sources (3) which are emitting in a specified spectral range, wherein the second light sources (3) differ from one another in the wavelength of their emission maximum, and wherein the second light sources (3) are installed in a housing (5) so that they irradiate the surface (O) of the marking when the housing is placed thereon under a third angle ($\beta 1$) which is specified differently from the first angle ($\alpha 1$),

c) a first means (2) located in the housing (5) at a second angle ($\alpha 2$) for the measurement of the intensities of the light specularly reflected by the surface (O) of the marking,

d) a second means (4) located in the housing (5) at a fourth angle ($\beta 2$) for the measurement of the intensities of the light specularly reflected by the surface (O) of the marking, and

e) a means (7) of automatic comparison of the measured intensities with the reference intensities stored for the respective light sources (1) for at least one specified color.

2. Device as defined in one of the preceding claims, wherein the specified spectral range has a width of less than 100 nm, preferably of less than 50 nm at half maximum intensity.

3. Device as defined in one of the preceding claims, wherein the light sources (1, 3) are light-emitting diodes, lasers or the free ends of the thereby connected light-conducting fibers.

4. Device as defined in one of the preceding claims, wherein the means of measuring the intensities has at least one photo diode (2, 4).

5. Device as defined in one of the preceding claims, wherein the first ($\alpha 1$) angle and the third ($\beta 1$) angle are located in a range from 5° to 60°, preferably from 15° to 45°.

6. Device as defined in one of the preceding claims, wherein a unit for the sequential illumination of the surface (O) with the light sources (1, 3) and for the measurement (2, 4) of the particular intensities of the reflected light in a defined sequence is provided.

7. Device as defined in one of the preceding claims, wherein the emission maximum of the light sources (1, 3) is in the near UV, in the visible or in the IR spectral range.

8. Device as defined in one of the preceding claims, wherein the duration of illumination and measurement is specified in dependence on the luminance characteristic of each of the light sources (1, 3) and/or the measuring characteristic of the means (2, 4) of measuring the intensities.

9. Device as defined in one of the preceding claims, wherein a mechanical, electronic or technical software unit is provided to offset the background light.

10. Device as defined in one of the preceding claims, wherein a unit is provided for the modulation of the light sources (1, 3) to separate the interference signals from the measuring signals.

11. Device as defined in one of the preceding claims, wherein at least 3 and not more than 12 first (1) and/or second (3) light sources are provided.

12. Device as defined in one of the preceding claims, wherein the means of automatic comparison or of calculation of the coordinates in the color range has a micro-controller (7).

13. Device as defined in one of the preceding claims, wherein an indication device (12), preferably a display, or

one or more additional light-emitting diodes are provided to indicate the results determined from the comparison.

14. Method for checking the authenticity of a forgery-proof marking with colors which change depending on the angle of observation, consisting of the following steps:

aa) Irradiation of surface (O) of the marking with several first light sources (1) installed in a housing (5) and emitting light in a specified spectral range at a first angle ($\alpha 1$), wherein the first light sources (1, 3) differ from each other in the wavelength of their emission maximum,

bb) Irradiation of the surface (O) of the marking with several second light sources (3) installed in a housing (5) and emitting light in a specified spectral range at a third angle ($\beta 1$) which is different from the first angle ($\alpha 1$), wherein the second light sources (3) differ from each other in the wavelength of their emission maximum,

cc) Measurement of the intensities of the light specularly reflected by the surface (O) of the marking at a second angle ($\alpha 2$) via a first means (2) for measuring the intensities at the second angle ($\alpha 2$) and located in the housing (5),

dd) Measurement of the intensities of the light specularly reflected by the surface (O) of the marking at a fourth angle ($\beta 2$) via a second means () for measuring the intensities at the fourth angle ($\beta 2$) and located in the housing (5), and

ee) Comparison of the measured intensities with reference intensities stored for the particular light sources (1, 3) for at least one specified color.

15. Method as defined in claim 14, wherein the specified spectral range at half maximum intensity has a width of less than 100 nm, preferably less than 50 nm.

16. Method as defined in one of the claims 14 or 15, wherein the angle of illumination ($\alpha 1$, $\beta 2$) and angle of measurement ($\alpha 2$, $\beta 2$) are specified by installing the light sources (1, 3) and the means (2, 4) of measuring the intensities in a common housing (5).

17. Method as defined in one of the claims 14 to 16, wherein light-emitting diodes, lasers or the free ends of thereby connected light-conducting fibers are used as light sources (1, 3).

18. Method as defined in one of the claims 14 to 17, wherein at least one photo diode (2, 4) is used as the means of measuring the intensities.

19. Method as defined in one of the claims 14 to 18, wherein the first ($\alpha 1$) and the third ($\beta 1$) angle are in a range from 5° to 60°, preferably 15° to 45°.

20. Method as defined in one of the claims 14 to 19, wherein the light sources (1, 3) are run sequentially in a defined order.

21. Method as defined in one of the claims 14 to 20, wherein the emission maximum of the light sources (1, 3) is located in the near UV, in the visible or in the IR spectral range.

22. Method as defined in one of the preceding claims 14 to 21, wherein duration of illumination and measurement is specified in dependence on the luminance characteristic of each of the light sources (1, 3) and/or the measuring characteristic of the means (2, 4) of measuring the intensities.

23. Method as defined in one of the claims 14 to 22, wherein background light is compensated via mechanical, electronic or technical software measures.

24. Method as defined in one of the claims 14 to 23, wherein the light sources (1, 3) are modulated to separate the interference signals from the measuring signals.

25. Method as defined in one of the claims 14 to 24, wherein at least 3 and not more than 12 first (1) and/or second light sources (3) are provided.

26. Method as defined in one of the claims 14 to 25, wherein the automatic comparison or the calculation of the coordinates in the color range is performed using a micro-controller (7).

27. Method as defined in one of the claims 14 to 26, wherein the result determined during the comparison is indicated via an indication device (12), preferably a display or one or more additional light-emitting diodes.

28. Method as defined in one of the claims 14 to 27, wherein a marking is used as the forgery-proof marking which has an electro-magnetic-wave-reflecting first layer (1) connected with an object on which layer an electro-magnetic-wave-permeable, inert second layer (3) with a specified thickness is applied, and wherein a third layer (4) consisting of metallic clusters is applied to the second layer (3).

29. Method as defined in claim 28, wherein at least one of the layers (1, 3, 4, 5) has a structure.

30. Method as defined in claim 28 or 29, wherein an electro-magnetic-wave-permeable, inert fourth layer (5) covering the third layer (4) is provided.

31. Method as defined in one of the claims 28 to 30, wherein the metallic clusters are made of silver, gold, platinum, aluminum, copper, tin, iron, cobalt, chromium, nickel, palladium, titanium or indium.

32. Method as defined in one of the claims 28 to 31, wherein the second (3) and/or fourth layer (5) is/are made of one of the following materials: metal oxide, metal nitrite, metal carbide, particularly of silicon oxide, silicon nitrite, tin oxide, tin nitrite, aluminum oxide, aluminum nitrite or polymers, in particular polycarbonate (PC), polyethylene (PE), polypropylene (PP), polyurethane (PUR), polyimide (PI), polystyrene (PS), polyethylene terephthalate (PET) or polymethacrylate (PMA).

33. Method as defined in one of the claims 28 to 32, wherein a uniquely identifiable coloring can be recognized at an interval between the first (1) and the third layer (4) of less than 2 µm.

34. Method as defined in one of the claims 28 to 33, wherein the layers (14, 16, 17, 18) is/are made via thin-film technology, such as PVD, CVD as well as printing technologies such as gravure printing.